Design for a Gravitational Wave Generator/Thruster V7
Part I

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Abstract

This device generates gravitational waves which can be utilized as a thruster or as a communication device. It is comprised of a linear antenna array that is injected with a Radio Frequency (RF) signal. The antennas are configured to convert electromagnetic (EM) waves into gravitational waves.

When the antennas are arranged in a linear phased-array configuration, a thrust is produced that allows the device to be used as a method of propulsion. Part I of this article describes the device when configured as a thruster and documents the test results.

Part II will document the test results of the device when configured as a gravitational wave transmitter. If the injected RF signal is modulated with an Intermediate Frequency (IF) signal, the gravitational waves produced are also modulated. The invention can then function as a communication device by using the gravitational waves as a carrier instead of EM waves. A gravitational wave detector at the receiving end will demodulate the gravitational waves, thereby extracting the original (IF) signal.

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Background Theory

Foamy Ether Theory (FET) [1] describes electromagnetic (EM) waves as distortions in the foam that are transverse to the direction of propagation. Figure 1a below shows that the foamy ether has maximum distortion (compression) at the positive and negative peaks of the EM wave. A gravitational wave, however, is a compression that is parallel to the direction of propagation (see Figure 1b). This is explained in more detail at: https://www.peterhahn.ca/the-photon.

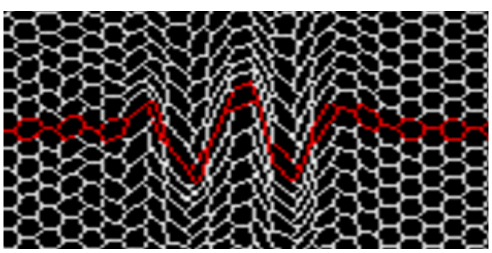

Figure 1a
EM wave through foamy ether

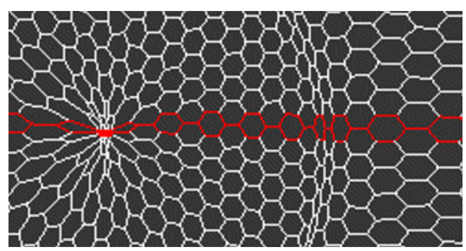

Figure 1b
Gravitational wave through foamy ether

According to FET, when two EM waves traveling in opposite directions meet, a compression of foamy ether (space) takes place between the waves. Screen captures of a simulation (using *ThreeDimSim*) of this compression is illustrated in Figures 2a to 2f. The figures show how the foamy ether is distorted by an array of four antenna pairs that are fed phase-shifted EM waves. The top red bar is a cross section of an antenna element where the RF signal is flowing towards the viewer, while the bottom red bar has the RF signal flowing away from the viewer. Figure 2a shows the beginning of the distortion created by the first antenna pair, followed by Figures 2b to 2d which show the progression. Figures 2e to 2f show how the compression wave continues to travel to the right even after the EM waves have completed their vertical distortions. This compression wave is equivalent to a gravitational wave. (Notice that no compression wave leaves the left side of the antenna array).

The full simulation can be viewed at: https://www.peterhahn.ca/gravitational-wave-generator.

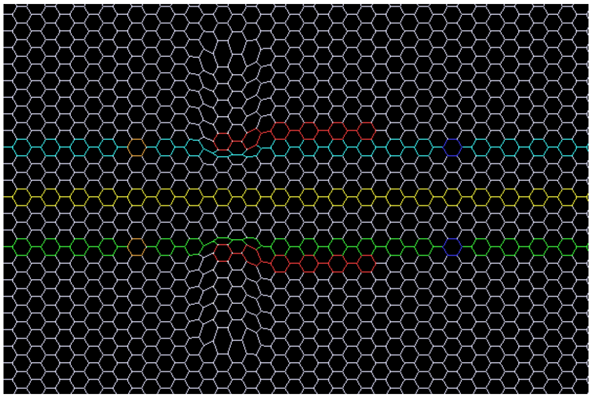

Figure 2a
EM Pulse on Antenna #1

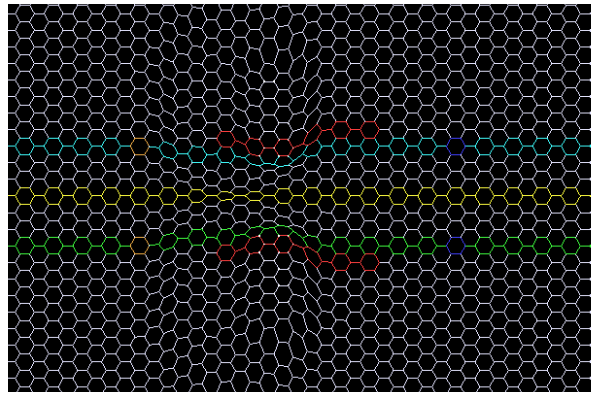

Figure 2b
EM Pulse on Antenna #2

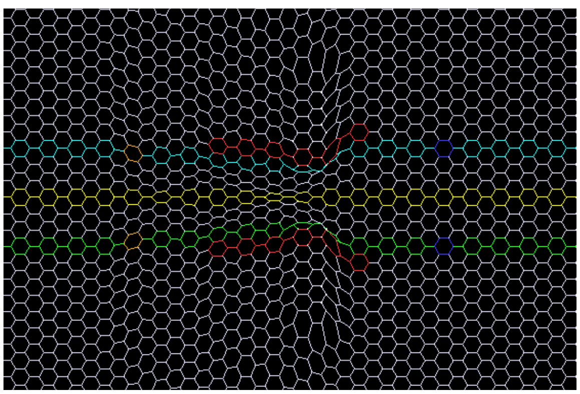

Figure 2c
EM Pulse on Antenna #3

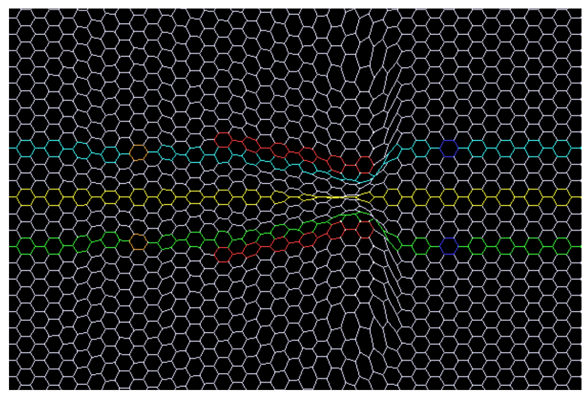

Figure 2d
EM Pulse on Antenna #4

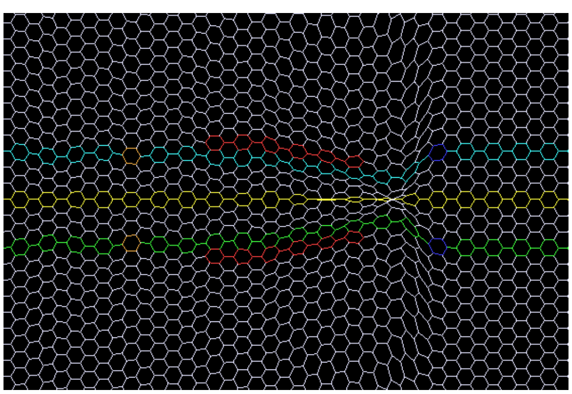

Figure 2e
Gravitational wave exits antenna array

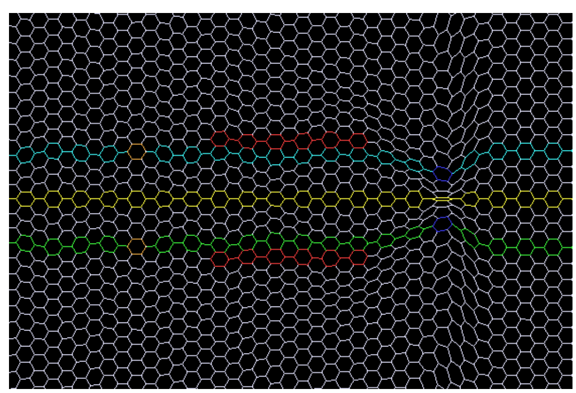

Figure 2f
Gravitational wave continues

The vertical distances between the orange cells on the left and the dark blue cells on the right were plotted in Figure 3a and 3b while the simulation was running. Figure 3a plots the vertical distances between the orange cells (orange line) and the dark blue cells (blue line) while the compression wave travels through the array. The sum of these *compressions* between the two dark blue cells on the right equals 339 (area between horizontal time points 9 and 29). The sum of the *stretching* for an equal amount of time (points 30 to 50) equals 113. Therefore, space on the right side of the array spends more time in a compressed state than in a stretched state. This imbalance will cause a force to occur on the device because the distortion pattern created between the blue cells is similar to the distortion created by the presence of matter. According to FET, the array will experience an attractive force towards this distortion.

Figure 3b shows an even greater imbalance when three pulses occur in succession. The first two pulses have a sum of compression values equaling 704, while the total time spent in a stretched state equals 57. Notice that much less distortion occurs on the left side of the simulation (orange line).

This process of using *phase-shifted, opposing* EM waves to create gravitational waves is the basis of this invention. Since the electric force is approximately 2.4×10^{43} times greater than the gravitational force [2], a significant thrust is therefore achieved.

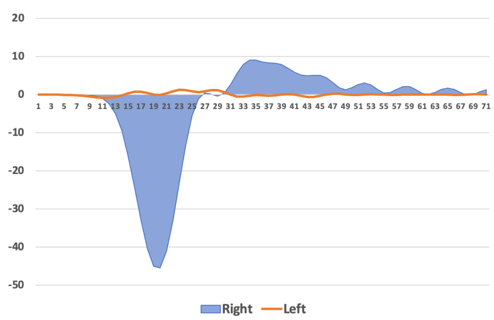

Figure 3a
Compression Plot: One Pulse

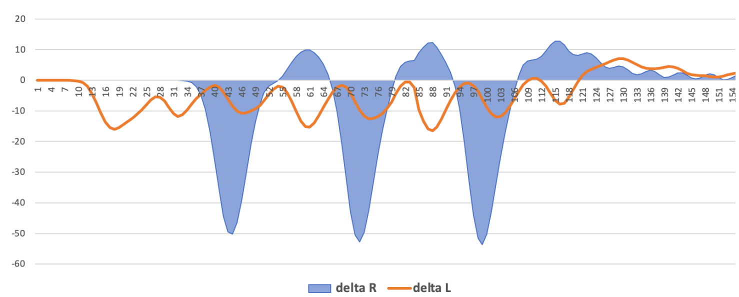

Figure 3b
Compression Plot: Three Pulses

This vertical squeezing of space between two opposing EM waves is analogous to the process of squeezing out the last bit of toothpaste from a nearly empty tube. Using your thumb and forefinger, you start from the back and progressively squeeze the tube towards the opening, thereby expelling the toothpaste.

Applications of a GW Thruster

A gravitational wave thruster has the following advantages over current propulsion technologies:

- The EMDrive that claims to use high frequency microwaves as a source of thrust has been proven ineffective [3].
- This invention uses opposing EM waves to generate gravitational waves so thrust ***is*** generated. This means that no propellant will be required, thus spacecraft could operate indefinitely provided they have a continuous source of electricity (i.e. solar). It can be used as a source of propulsion to maneuver various objects, such as:

a. Aircraft
b. Spacecraft (to land on the Moon, Asteroids (mining), Planets)
c. Space-based telescopes (i.e. James Webb [4], Hubble [5])
d. Satellites
    i. To sustain orbital altitude
    ii. For deorbiting (decommissioning)
    iii. To maneuver to legacy satellites for refuelling.

- Does not kick up dust while landing on the moon.
- The invention may also be used as a device that reduces the gravitational pull on an object when that object is placed between a GWT and the earth. The effect could potentially be strong enough to make the object essentially weightless, while still located on the surface of a planet. This could be used to run experiments in a weightless environment without the need for going into orbit.

Description of How the Device Works

An alternating current (i.e RF signal) that is fed through a conductor generates EM waves that propagate away from the conductor at the speed of light. However, if two conductors are placed adjacent to each other and fed an AC signal in opposing directions, there is a rhythmic compression and stretching of empty space between the conductors. This compression of space is similar to what occurs in a gravitational wave. The EM waves created by the two opposing signals cancel each other out, but the gravitational wave propagates into the surrounding space. The frequency of the gravitational wave is twice that of the frequency of the AC signal because a compression takes place each time the current flow changes direction and reaches a maximum.

The current prototype was built with the configuration illustrated in Figure 4. Oscillator (1) from Silicon Labs was used to generate a 466MHz continuous sinewave (however, any frequency will work). The output of the oscillator is connected to the input of a programable attenuator (2). This attenuator is used to set the power level and is also used as an on/off switch for the RF signal. The attenuator feeds a Low Noise Amplifier (3) which is connected to a six-way RF power divider (4). Five outputs of the power divider are connected to programmable attenuators (5) which feed into the phase shifters (6). These phase shifters provide adjustable phase shifts of the RF signal to each antenna array element (10). RF Power Amplifiers (7) provide a boost in the power level sent to each antenna element. The antenna array element (A) on the far left receives the RF signal first, followed by the next element to the right, until array element on the far right (E) receives the signal last. Each of the array elements are separated by 1/10th of a wavelength (≈6cm). A phase shift of 1/10th wavelength feeding the array elements, separated by 1/10th wavelength, creates a gravitational wave pulse that travels from left to right. The gravitational pulses exit the device on the right, thereby creating a thrust that *pulls* the device from left to right as indicated by arrow (11).

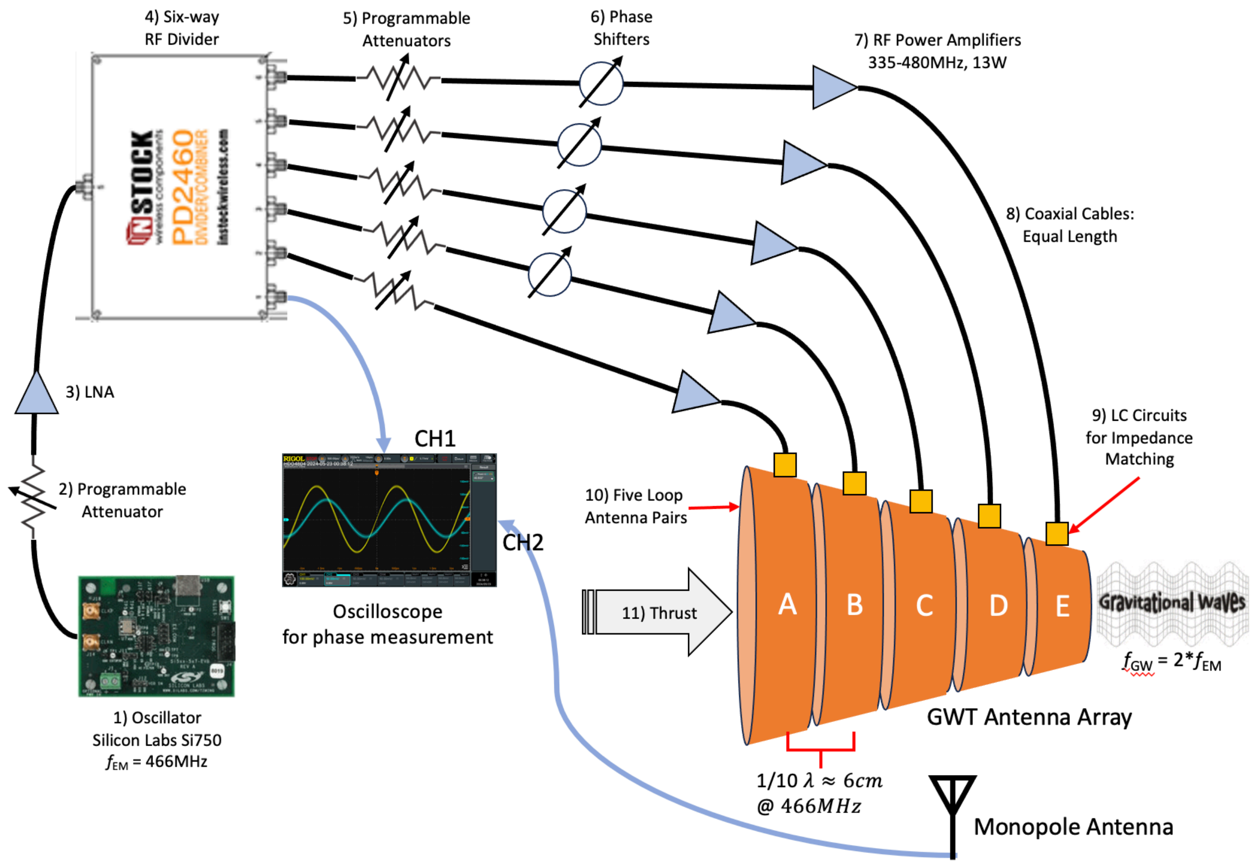

Figure 4
General Configuration of Prototype

The current prototype uses a pair of loop antennas that are placed adjacent to each other to form one antenna array element. Figure 5 shows a cutaway view of the internal components of one antenna array element. It is comprised of two concentric loop conductors insulated from each other. The two conductors are fed opposing AC currents that are 180 degrees out of phase. Loop antenna pair A (Figure 4) is constructed so its circumference is equal to one wavelength of the RF signal (64.3cm at 466MHz). Antenna elements B to E are constructed with progressively smaller diameters to provide further squeezing/compressing of space. An adjustable impedance matching LC circuit is attached to each antenna pair (see item 9 on Figure 4). (Theoretically, any antenna shape has the potential to generate gravitational waves, provided that it is configured, such that at least two insulated antennas are placed adjacent to each other and are fed opposing AC currents).

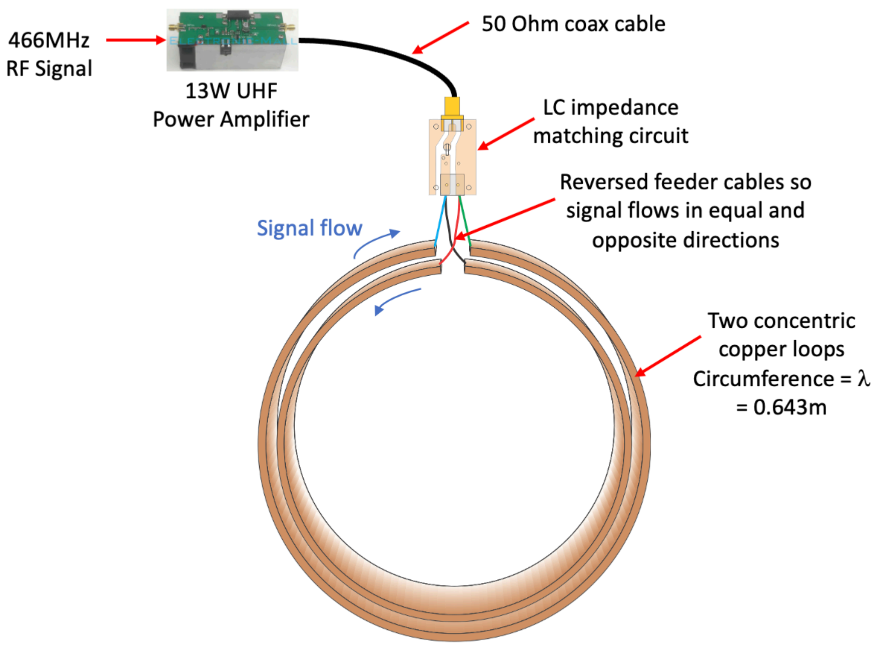

Figure 5
Cutaway of a Loop Antenna Element

Antenna Properties

A NanoVNA [6] (Vector Network Analyser) was used to measure the properties of the antenna array element prototypes. Plots of the results are as follows:

- Figure 6a is a Smith Chart [7] plotting the actual reactance values of the five antenna array elements. Resistance value is approximately 148Ω and reactance is -j177Ω at 466MHz.
- Figure 6b is the LC circuit needed to match the impedance of the antennas to a 50Ω coax cable.
- Figure 6c is a Smith Chart plot of the antenna elements with impedance matching circuits installed.
- Figure 6d is a plot of the Standing Wave Ratio (SWR) of matched antenna elements.

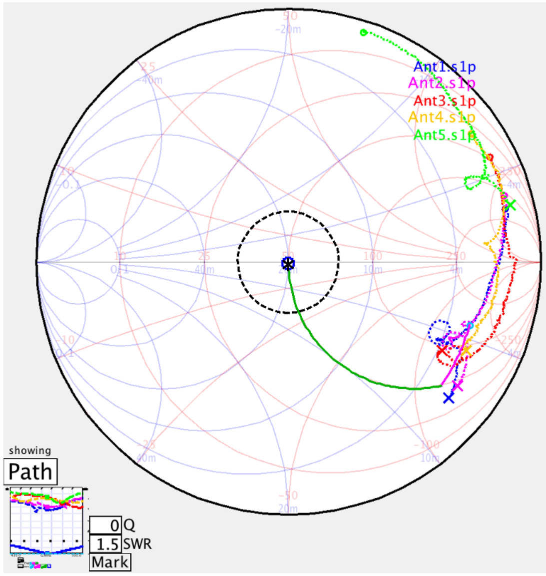

Figure 6a Smith Chart Plot
Unmatched Impedances

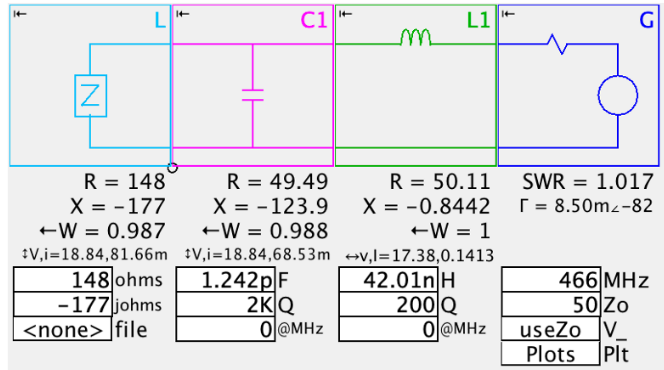

Figure 6b
Impedance Matching LC Circuit

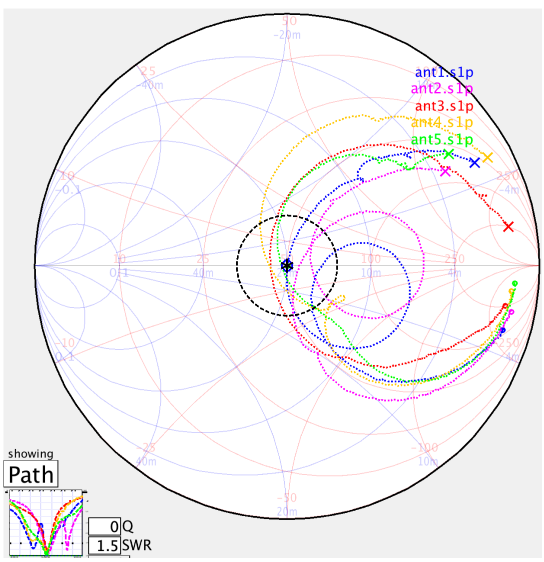

Figure 6c Smith Chart Plot
Matched Impedances

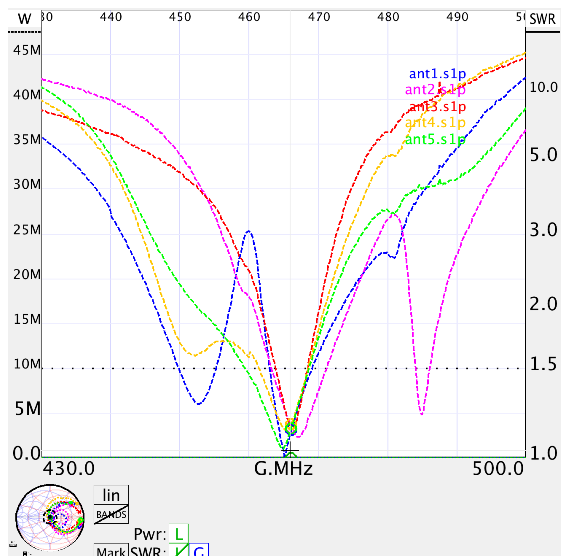

Figure 6d SWR Plot
Matched Impedances

Phase Shift/Delay

Incremental phase delays between antenna elements are produced by using adjustable phase shifters (See Figure 4). Figure 7a is a calculated plot of five sinewaves where each wave is progressively shifted by 30^0. Figure 7b uses the same calculated values as Figure 7a but plots the *absolute value* of the sine waves instead. This is because a gravitational (compression) wave is produced at both the positive and negative portion of the RF sinewave. (The frequency of the resulting gravitational wave is twice that of the RF signal). Figure 7c shows a plot of the actual measured phase delays created by the phase shifters, using a monopole antenna (see Figure 4). Figure 7d plots the phase delays with their associated power values measured at the output of each RF amplifier.

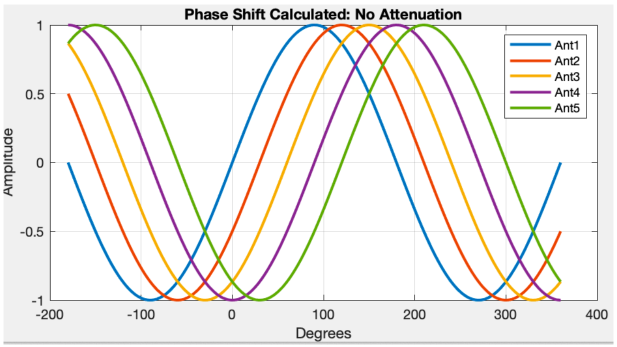

Figure 7a
Phase Delay 30^0 Calculated EM Waves
[0;30;60;90;120] Degrees

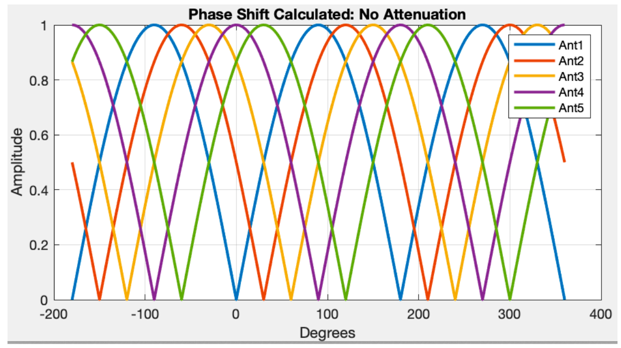

Figure 7b
Phase Delay 30^0 Calculated G Waves

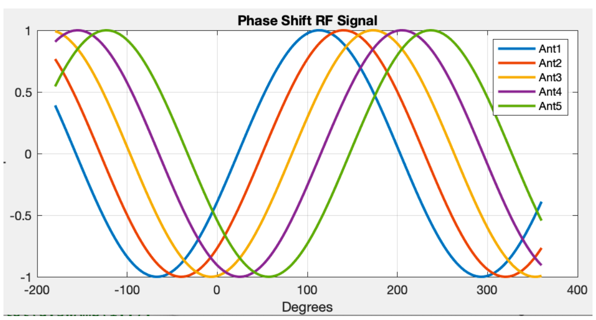

Figure 7c
Measured Phase Delay Nov. 22, 2024
[23;50;83;115;147]

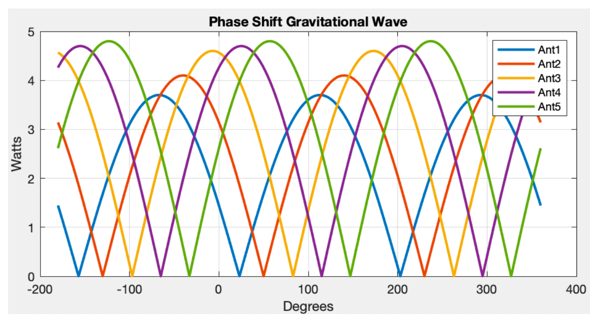

Figure 7d
Measured Amplitude Plus Phase Delay
Power = [3.7;4.1;4.6;4.7;4.8] Watts

Figure 7e is a polar plot that shows the phase delays and power levels of each antenna element.

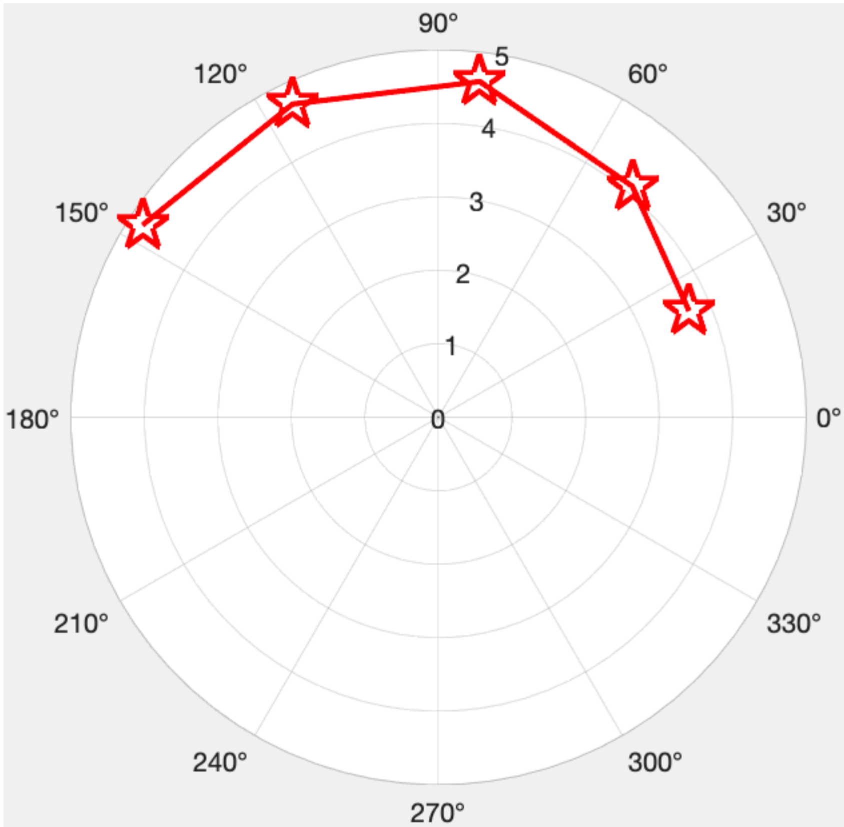

Figure 7e Polar Plot
Measured Phase Delay Nov. 22, 2024
Phase = [23;50;83;115;147] Degrees
Power = [3.7;4.1;4.6;4.7;4.8] Watts

Measuring Thrust

Test Apparatus

Measuring the movement of the device was accomplished by using the test configuration as shown in Figures 8 and 9 and Photos 1 and 2. The antenna array was mounted on the floor of a double pendulum device. The antenna array and mounting bracket assembly can be lifted out and rotated 180^{O} so that thrust can be measured in either direction. A laser diode projected the laser light onto a mirror which was fixed on the pendulum floor at a 45^{O} angle. The laser beam reflected off the mirror and was picked up by a webcam (lens removed). The output of the webcam was fed into a computer which recorded the left and right movement of the device.

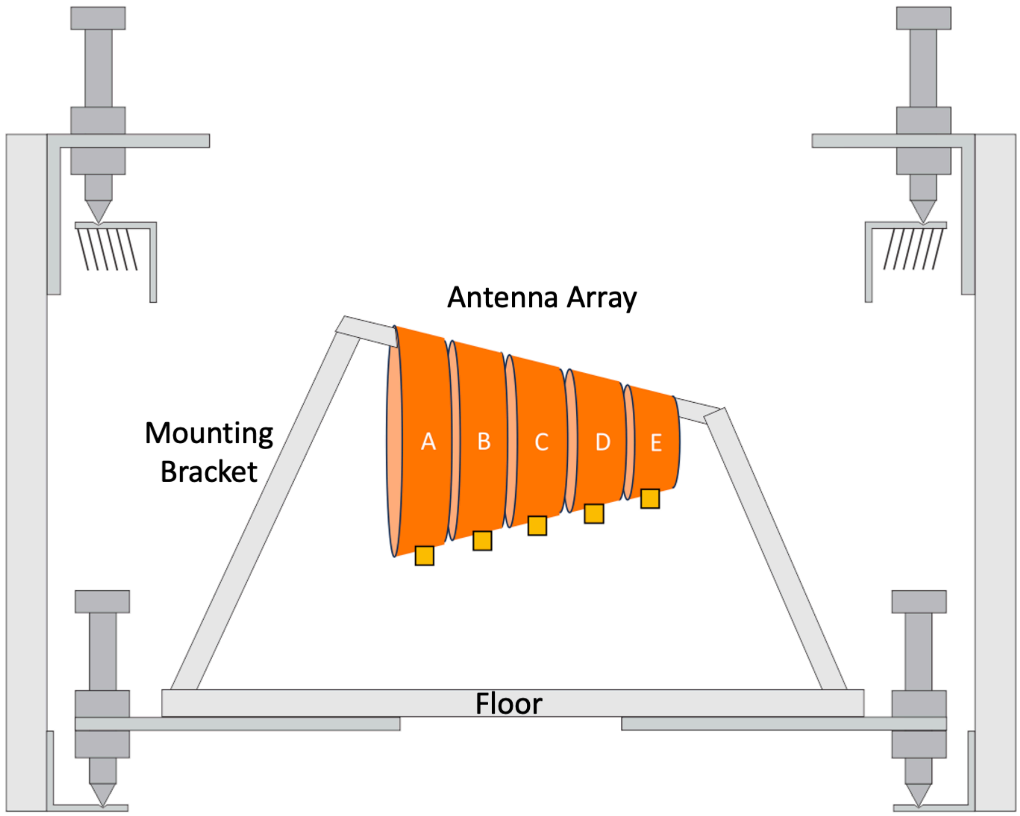

Figure 8
Pendulum and Antenna Array

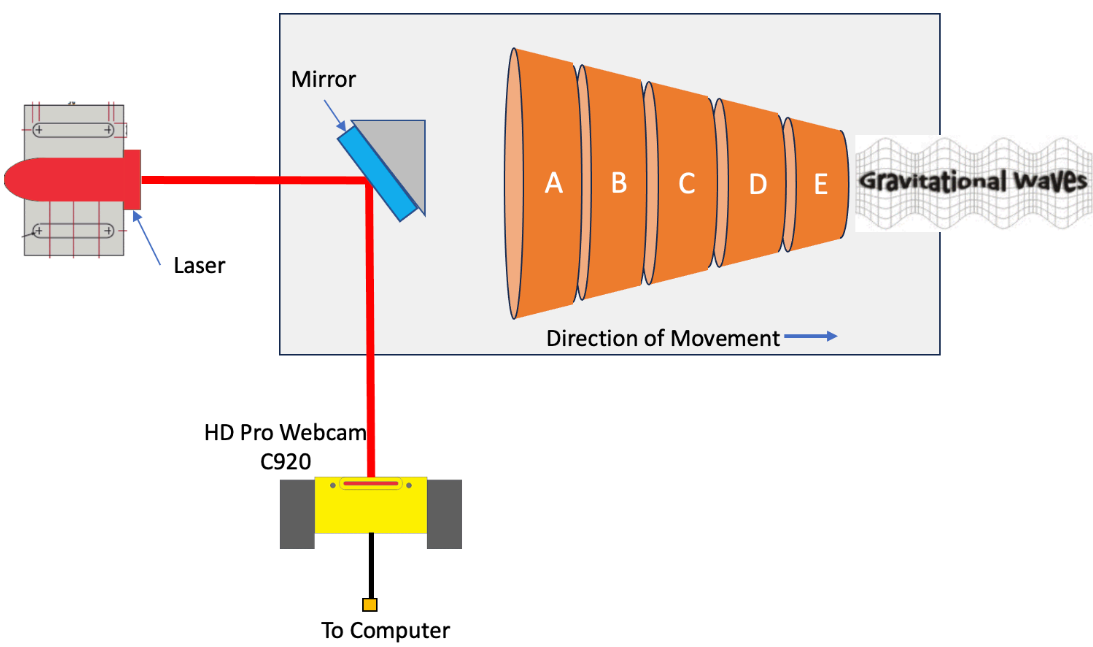

Figure 9
Top View of Test Configuration

Image Acquisition and Plotting

Figure 10 below shows a block diagram of the image acquisition configuration. The first block is a webcam that captures the laser beam image at thirty frames per second. The next block captures each 100x1920 pixel frame and sends it to a MATLAB function which senses the left and right beam movement by calculating the mean-of-a-histogram for each frame. A typical frame image is displayed in Figure 11 and a plot of the beam strength is shown in Figure 12. The Scope (in Figure 10) plots the movement of the beam in real time which is then stored for post processing.

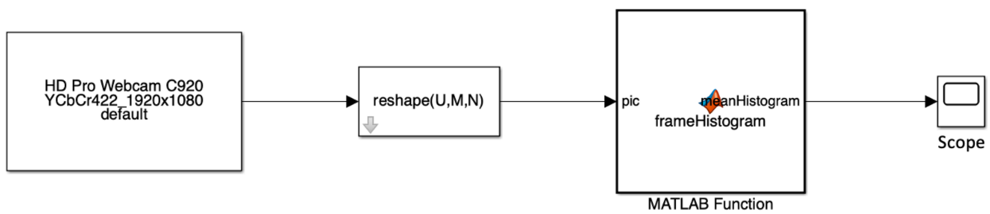

Figure 10 Webcam live image acquisition block diagram

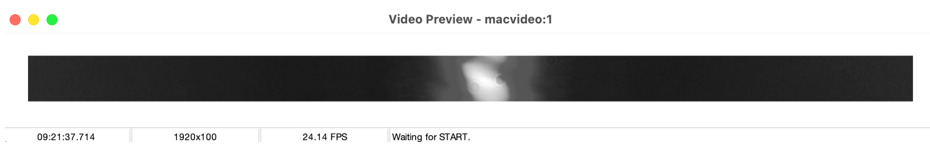

Figure 11 Camera image of laser beam: 100x1920 pixels

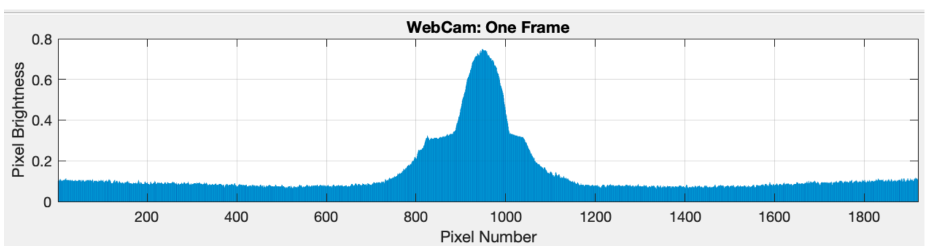

Figure 12 Plot of a single frame capture

The equation for calculating the mean of a histogram is:

$$\mu = \frac{1}{N}\sum_{i=0}^{M-1} iH_i$$

Where:
N is the number of points in the signal
M is the number of points in the histogram
H_i are the values of the sampled signal

```
% function to calculate mean of a histogram
for each frame capture

function meanHistogram = frameHistogram(pic)
  pixelWidth = 1920;
  mymean = 0;
  frameSum = 0;
  mm = transpose(mean(pic));
  for pixel = 1:pixelWidth
    mymean = mymean + pixel * mm(pixel);
    frameSum = frameSum + mm(pixel);
  end
  meanHistogram = mymean/frameSum;
```

Power Switch

A programmable attenuator (device 2 in Figure 4) was utilized to provide a controllable on/off signal to the GWT (see Figure 13). Normally, the attenuation is set to 30.5db so no signal is present. When enabled, the attenuation ramps down to 0db over a one second time interval. It remains at 0dB for nine seconds, then ramps back up to 30.5dB. This ramping prevents any sudden surges of power to the feeder circuitry and GWT antenna array.

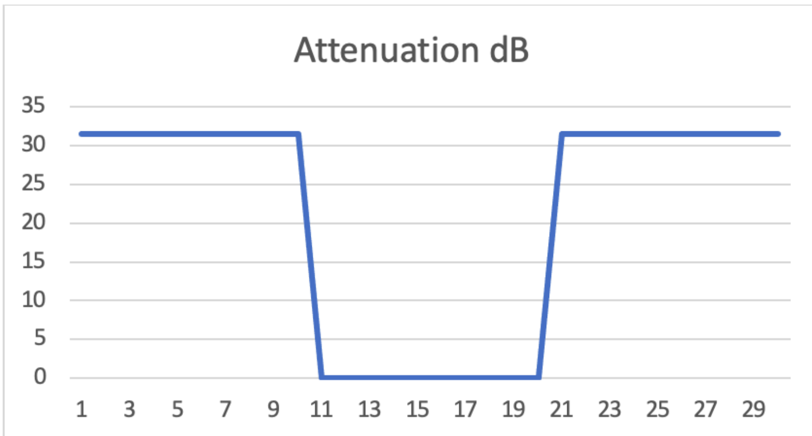

Figure 13 Programmable Attenuator Plot

Imitating Thrust Using Electromagnet

An electromagnet was included in the setup to determine what an actual (known) force on the pendulum testbed would look like. Figure 14 below plots the resulting GWT displacement when power is applied to the electromagnet for a duration of 20 seconds.

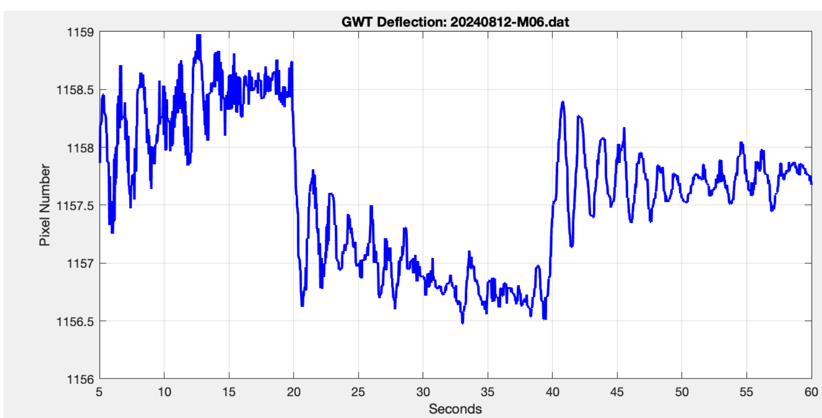

Figure 14
Measured displacement using test electromagnet
Power applied between 20 and 40 second mark.

Test Results

A total capture time of 30 seconds was used for testing. No power was applied to the antenna array for the first 10 seconds; power was applied for 10 seconds and then shut off for the remaining 10 seconds. Figure 15a is plot of the average of ten test runs, clearly showing that the antenna array moved to the left while power was applied to the device. Figure 15b shows samples of four typical test runs.

The natural pendulum motion of the suspended device caused the laser beam to oscillate between pixel numbers 1044 and 1045 for the first 10 seconds. It then moved down to pixel positions 1043 to 1043.5 during the next 10 seconds as a result of the power being applied to the antenna array. The last 10 seconds showed the device returning to its original position after the power was removed. The plot shows that the total movement of the device was equal to 1.25 pixels of the line scan camera. (Each pixel is 2.86μm in width).

Using the pendulum force equation ($F = mg \sin\theta$), the thrust generated by the GWT was calculated to be 99.07μN of force when 5.3 Watts of RF power was applied to the antenna array.

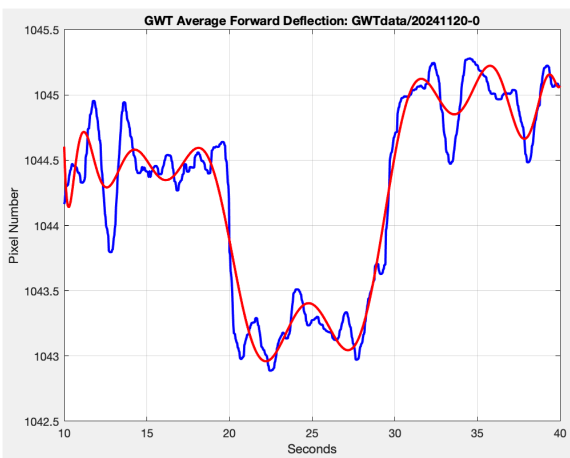

Figure 15a
Average of 10 deflections with GWT mounted in forward direction ←
1044.5 down to 1043.25
Deflection = 1.25 Pixels

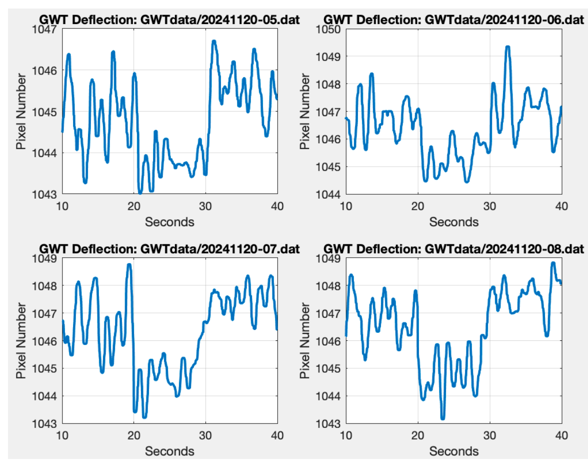

Figure 15b
Typical test runs
Forward direction ←

The antenna array was rotated horizontally by 180 degrees to ensure that the thrust produced would occur in the reverse direction. Figure15c below is a plot of the average of ten test runs clearly showing that the GWT moved in opposite (left to right) direction. The total average deflection measured was equal to two pixel widths. This calculates to a force of 158.51μN.

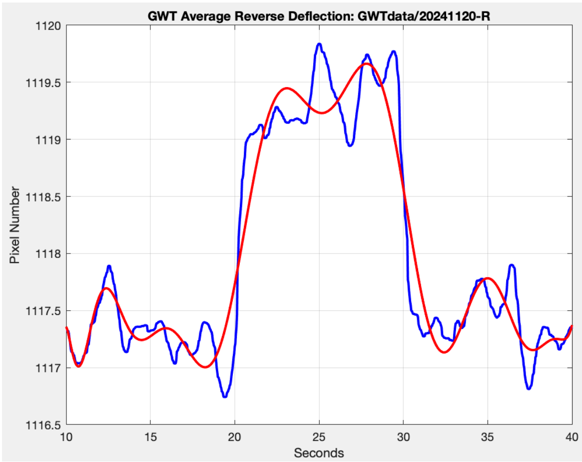

Figure 15c
Average of 10 deflections with GWT mounted in reverse direction →
1117.25 up to 1119.25
Deflection = 2 pixels

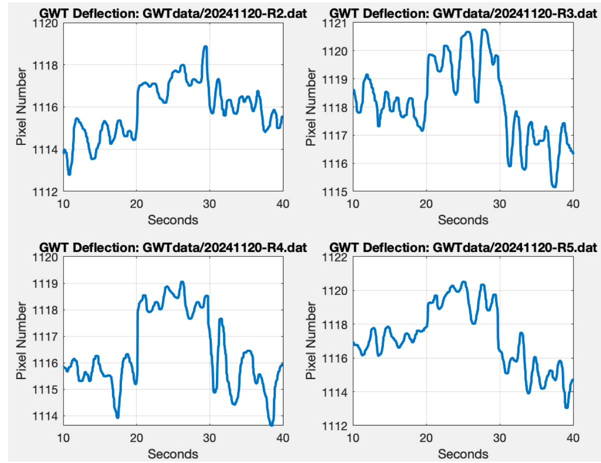

Figure 15d
Typical test runs
Reverse direction →

Figures 16a to 16d are the results of a repeat test done on another day, with more power delivered to the antenna array.

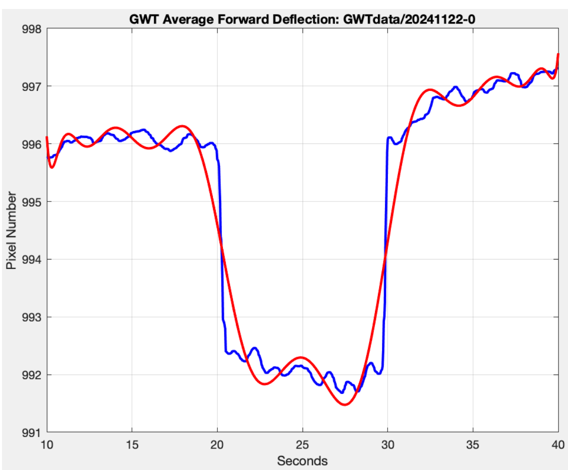

Figure 16a
Average of 10 deflections with GWT mounted in forward direction ←
996 down to 992
Deflection = 4 Pixels

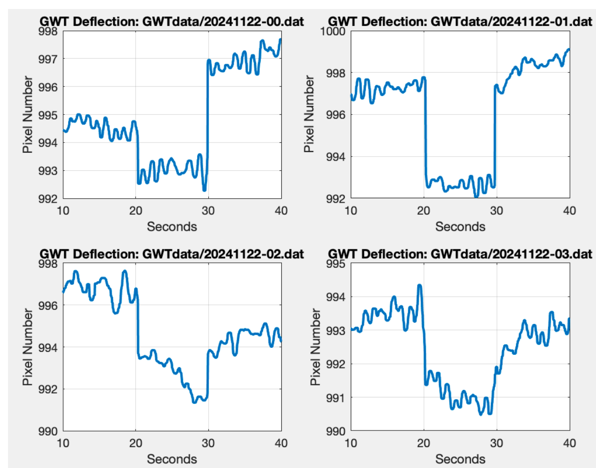

Figure 16b
Typical test runs
Forward direction

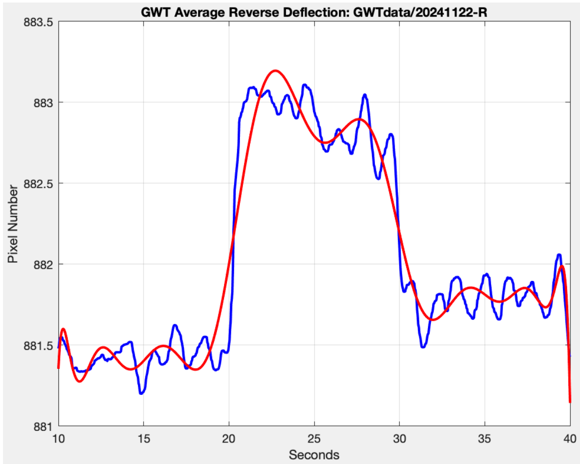

Figure 16c
Average of 12 deflections with GWT mounted in reverse direction →
881.5 up to 883
Deflection = 1.5 pixels

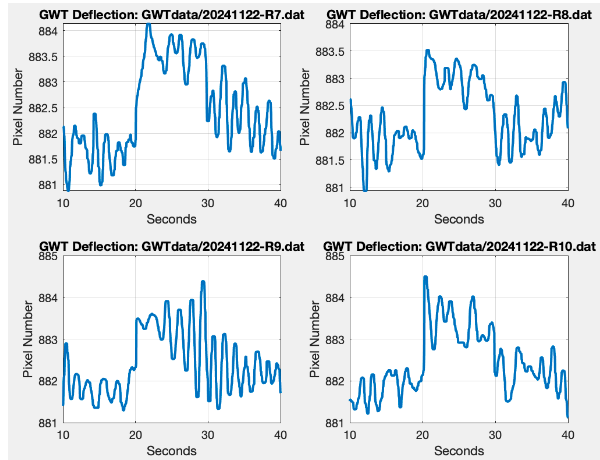

Figure 16d
Typical test runs
Reverse direction

Table 1 gives a summary of the results with data that includes pendulum force and thrust efficiency.

Test Date	Direction of Deflection	Deflection in Pixels	Deflection µm	Power Watts	sinϑ	Pendulum Force µN	Thrust Efficiency µN/Watt
2024-11-20	Left	1.25	3.575	5.3	3.972E-06	99.07	18.69
2024-11-20	Right	2	5.72	5.3	6.356E-06	158.51	29.91
2024-11-22	Left	4	11.44	21.9	1.271E-05	317.03	14.48
2024-11-22	Right	1.5	4.29	21.5	4.767E-06	118.89	5.53

Table 1 Test Result Summary

Conclusion

One of the claims of Foamy Ether Theory (FET) is that electromagnetic (EM) waves and gravitational waves (GWs) are distortions of the foamy ether. EM wave distortions are transverse to the direction of propagation and GW distortions are compression waves that are parallel to the direction of propagation (similar to sound waves). As a result of this view, it became apparent that EM waves could be manipulated in such a way as to produce gravitational waves. Snapshots of a simulation displayed in Figures 2a-2f show how this is accomplished. Using EM waves to generate GWs enables the device to create a continuous thrust without the need for propellants, since EM waves can be generated by electricity alone. This makes for a device that is ideal for space travel because it can operate indefinitely, as long as there is a constant supply of electricity.

Discussion

Much trial and error were required to generate an effective signal to the antenna array. It had to be set to just the right frequency, phases and power levels. The circuitry was prone to interference and drifting and required adjustments whenever anything was modified. The impedance matching circuit, attenuators and phase shifters required retesting and recalibrating each time the system was powered up and each time changes were made. Therefore, a high level of confidence was only achieved when ten consecutive runs with the same results were produced.

Going Forward

The next step is to solicit further testing from an independent second party. Further validation will be achieved when a second device is built, with a similar design, that produces thrust through the generation of gravitational waves. Testing the device in a vacuum chamber is required to remove the possibility of alternative causes of thrust, such as heat dissipation, magnetic interference or static electric forces.

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Photos

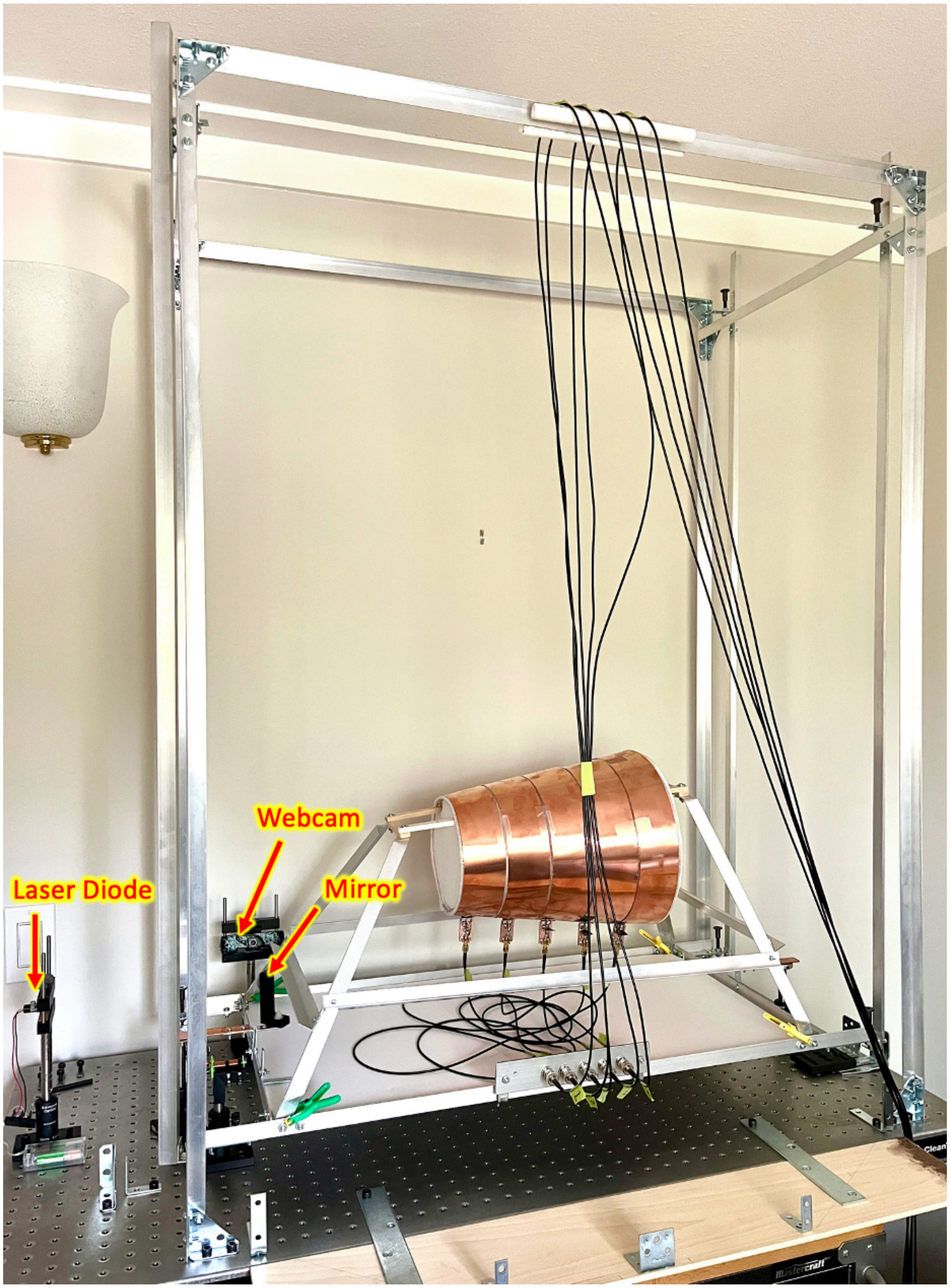

Photo 1
Antenna Array and
Pendulum Configuration

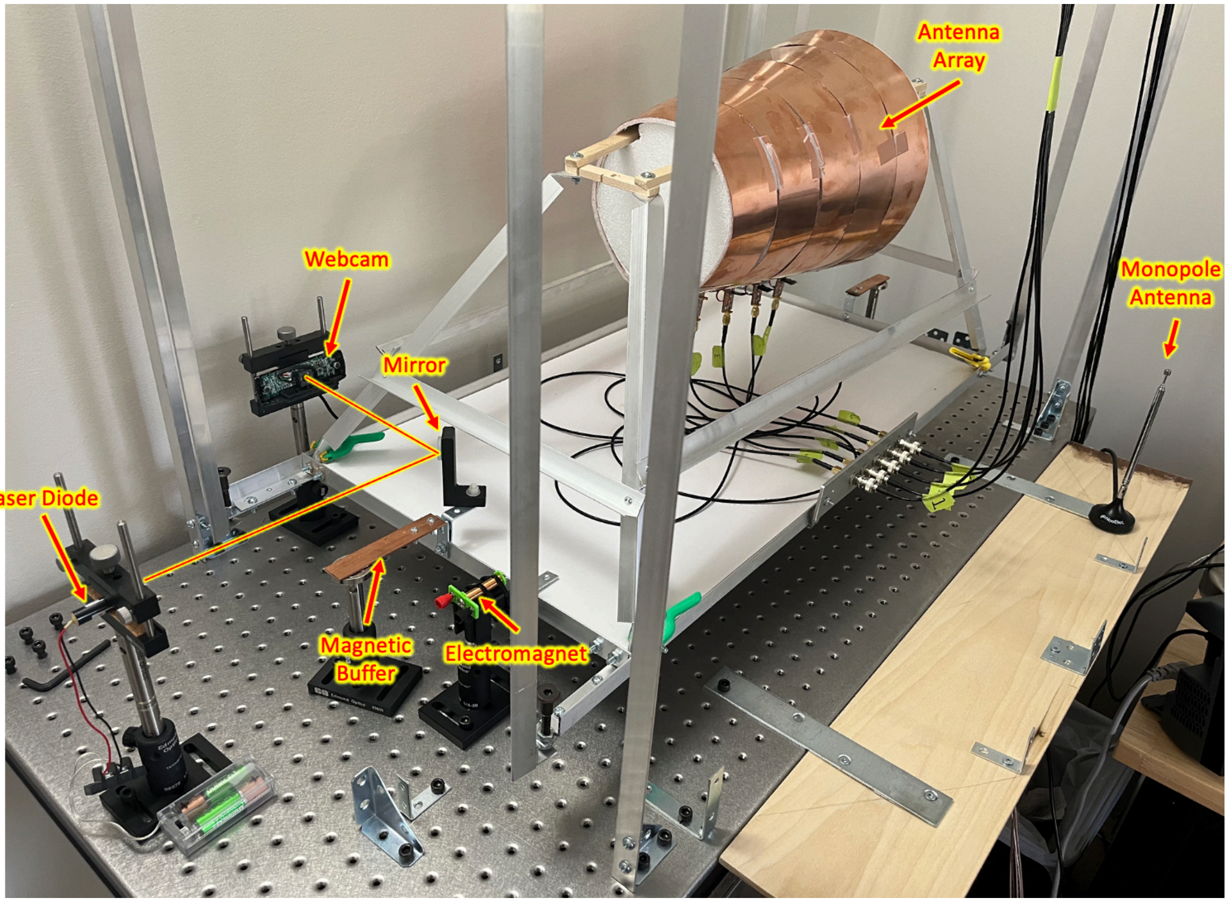

Photo 2
Test Apparatus Components

Photo 3
LC Circuit Boards Connected to
Antenna Array

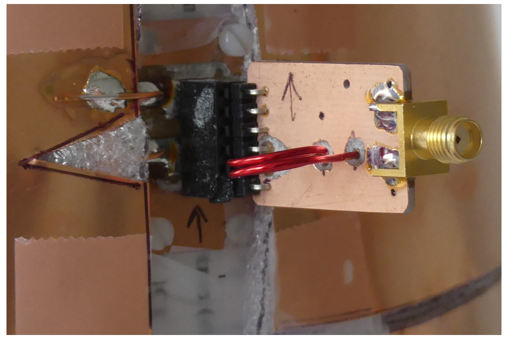

Photo 4
LC Circuit Board

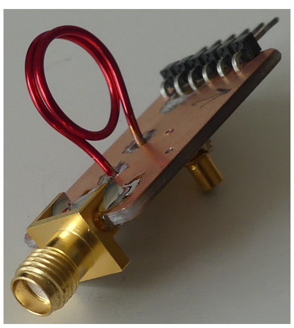

Photo 5 Inductor:
Number of Turns: 2
Diameter: 11mm
Wire diameter: 1.024mm
(18AWG)
Inductance: 71nH

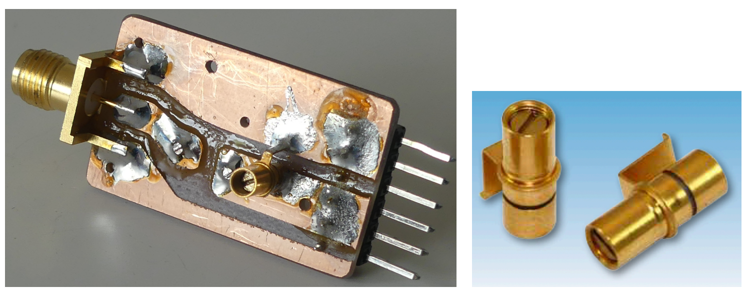

Photo 6 Adjustable Capacitor
https://www.knowlescapacitors.com
CAP TRIMMER 0.6-4.5PF 500V SMD
27273-3R5

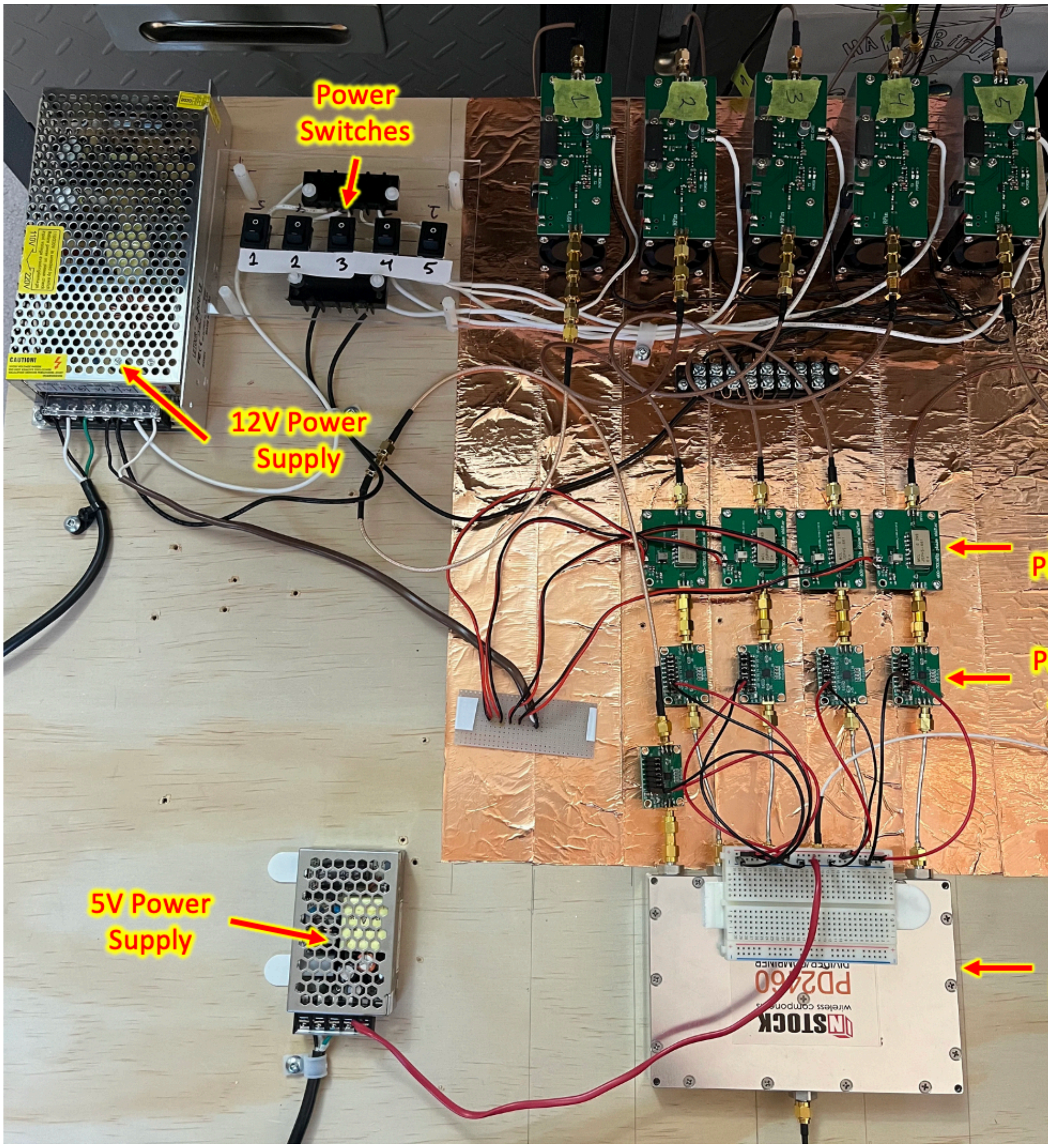

Photo 7
Feeder Circuitry